Research article

A cross-sectional study of the socio-demographic and epidemiological factors associated with childhood cancer in Cali, Colombia☆

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A R T I C L E   I N F O

A B S T R A C T

This study investigates the occurrence of childhood cancer between the years 2015 and 2016 in the city of Cali, Colombia, with respect to: a) sociodemographic characteristics, b) type of cancer, c) epidemiological weeks of cancer and d) comparative survival according to health system affiliation by consolidating the records notified to the municipal health secretariat. Statistically significant differences were found between the groups analysed in relation to the variables related to the type of cancer (p = 0.006). With respect to the proportion of cancer mortality between the years 2015–2016 there was no significant change, even though survival increased in the year 2016. The implications for collective health and public policies in Latin America are discussed.

1. Introduction

Cancer is one of the leading causes of death in the world. Every year, 300,000 children between the ages of 0 and 19 are diagnosed with cancer [1]. In Colombia, a middle-income country, the cure rate is approximately 20% [2, 3, 4]. Improving results depends on early and accurate diagnoses, which in low- and middle-income countries does not happen [2, 3] due to conditions of social inequity, for which the generation of primary data in care units is urged.

Also, because, there is a different behavior with respect to hematologic and non-hematologic cancer. According to GLOBOCAN in 2022, cancer has a prevalence of 46.0 cases in Colombia between the ages of 0–19 years, an incidence of 14.3, and a mortality of 5.3 per 100,000 thousand inhabitants. These epidemiological indicators vary according to the type of cancer: leukemia with a prevalence of 18.9 and incidence of 5.2, a mortality rate of 2.3; breast cancer with an incidence of 0.15, mortality of 0.01, and prevalence of 0.14. Hodgkin's lymphoma 1.4, mortality of 0.04 and incidence of 0.54, kidney prevalence of 2.9, mortality of 0.18 and

incidence of 0.63, multiple myeloma prevalence of 0.01, mortality 0.0, and incidence of 0.04, bladder incidence of 0.01 mortality and prevalence of 0.0, central nervous system and brain, the prevalence of 4.2, mortality of 0.84 and incidence of 1.5. This points out how blood-related cancer is much more frequent than non-hematologic cancer [5].

In Colombia, there is little up-to-date information on the incidence of childhood cancer. The National Cancer Observatory estimated a rate of 2.5 cases per 100,000 individuals under 15 years of age in 2010. For its part, the Vigicancer group, in conjunction with the population-based cancer registry, identified 1548 new cases of childhood cancer in the period from 1992 to 2011, that is, 77.4 new cases per year [6].

In the pediatric population in Colombia, cancer is a complex disease that does not represent more than 3% of new cancer cases, however, the high mortality rates due to pediatric acute leukemias despite the slight decrease in recent years [4] continues within the objectives of global health policies.

However, even with the technological and research advances in cancer treatment, the figures are worrisome and more than 20% of

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children die and most of the survivors do not have a high quality of life [7, 8, 9]. In this regard, the study seeks to fill the gap in the characterization of childhood cancer between 2015 and 2016, respect to: a) socio-demographic characteristics, b) type of cancer, c) epidemiological weeks of cancer and d) comparative survival curve according to health system affiliation.

This provides a data system to promote quality improvement in primary health care.

In fact, the distribution of wealth and access to health services, in particular affiliation to the subsidized or contributory system, exemplifies a social and economic difference typical of developing countries, such as Colombia. In this sense, the study shows in epidemiological weeks and survival weeks, the behavior of cancer in children to show how affiliation to the health system can affect survival, as well as the frequency of childhood cancer, which has been little visible to the research sector.

2. Methodology

A retrospective descriptive observational study was conducted, using data on childhood cancer presented in the population under 18 years of age for the period from January 1, 2015, to December 31, 2016. Therefore, it corresponds to a secondary source coming from the database of the obligatory notification cards reported to the SIVIGILA (Epidemiological Surveillance System) of the Municipal Public Health Secretariat of Santiago de Cali.

The data in the study represent the general population. According to Cali in figures 2016, the number of inhabitants in Cali corresponded to 2,394,925 of which 2,358,302 resided in the municipal capital, or 98.5% [10]. In turn, the study included the entire database of cases reported by the mandatory national notification system SIVIGILA of the city.

Likewise, the city of Cali, is among the main cities of Colombia and, given its infrastructure in specialized equipment for cancer treatment, has become a city that receives the rural population and small cities of the southwest of Colombia [11].

It is evidenced in figures (2018) that 25.45% of notifications of oncological diagnosis in children in the city of Cali are from people living outside Valle del Cauca. In 2017 the percentage of notifications from patients residing in other departments of Colombia is 25.5%.

The notification processes vary according to the Care Center, finding that this 25.45% (2018) and 25.5% (2017) presents 95.6% of notification from Oncology Centers located in the main departments of the country (Bogotá, Atlántico, Valle del Cauca, Antioquia, Santander, Risaralda) [12].

The National Public Health Surveillance System - SIVIGILA created different cards which study non-communicable diseases, communicable diseases, mental health and external cause injuries, among them the INS 115 code that corresponds to cancer in children under 18 years of age, in which there is a list of basic data (names and surnames of the patient, type of identification and identification number), then it indicates the type of cancer in which there are: 1. Acute myeloid leukemia, 3. Other leukemia, lymphomas and reticuloendothelial neoplasms, 5. Tumors of the central nervous system, 6. Neuroblastoma and other tumors of peripheral nerve cells, 7. Malignant bone tumors, 11. Soft tissue and extraosseous sarcomas, 12. Trophoblastic and other gonadal germ cell tumors, 13. Malignant epithelial tumors and melanoma, 14. Important data such as date of treatment initiation, consultation for second neoplasm, current consultation for relapse, initial diagnosis record and finally laboratory data and diagnostic methods are also taken into account [13].

And also, Cali represents 4.9% of the population in the country, however with respect to pediatric oncology services in our country only 19 of the 32 Departments of Colombia have enabled some pediatric oncology service, centralized in six departments: Bogota, Atlantico, Valle del Cauca, Antioquia, Santander, and Risaralda, who can provide enabled pediatric consultation, pediatric hospitalization, and chemotherapy services and only Atlántico, Bogota, Santander, and Valle del Cauca have

pediatric surgery and emergency services for the pediatric oncology patient. In this sense, Cali, as the capital of Valle del Cauca is representative with respect to the management of pediatric oncology patients at the national level [10].

As we analyzed the contributory and subsidized health regime, in Colombia, in order to access the contributory regime one must earn at least one minimum wage, which corresponds to approximately 270 dollars. In 2017–2018, 59.54% of the patients notified by SIVIGILA belonged to the contributory regime and 36.42% to the subsidized regime. In socio-economic terms reported for 2015, 83.7% live in socioeconomic strata 1, 2, 3: 23.7% low - low, 30.5% low, medium-low 29.5%. While 16.2% live in socioeconomic strata 4, 5 and 6: medium 7.9%, medium-high 6.3% high 2.2% respectively. In turn, the percentage of people living in poverty is 16.5%. In relation to health per 100,000 inhabitants, there are 217 doctors and 258 nurses per 100,000 inhabitants, in our study, we observe an increase in affiliations to the contributory regime we believe related to the decrease in the percentage of people living in poverty and the increase per capita in US 5,148 for the city, however, the sector with a higher variation in consumer prices was the health sector between 2015 and 2016 of 8.44, 8.43 and 9.19 in the high, medium and low-income levels respectively [10].

There were described all the variables contained in the notification card of Cancer in children under 18 years old, code INS 115, depending on the type of variable, for the quantitative ones it was evaluated the normality using Shapiro-Wilk's test, given that the quantitative ones presented normality, it was used average and standard deviation.

The cases diagnosed through survival analysis using the Kaplan-Meier method were described in the two years of follow up for all cancers, 30 records were excluded taking into account that, in the follow up and case classification, it was reported as ruled out or misdiagnosis. The total number of participants was a cohort of 513 cases in which survival was calculated. The Log-Rank test was applied to compare the curves at a 5% significance level. Statistical processing was done using SPSS software version 24.

2.1. Ethical considerations

The research was governed by the provisions of Resolution 8430 of 1993, of the Ministry of Health in Colombia, according to Article 11 was an investigation without risk by the use of a secondary database. It was endorsed by the ethics committee of the San Martin-Cali University Foundation and authorized by the Departmental Health Secretary of the Valley.

3. Results

The average age of the youngest cancer patients behaved similarly in both years, this was 8 ± 5.3 and 8.7 ± 5.4, respectively for 2015 and 2016. In relation to sex there were no differences but there was a slight decrease in the proportion of boys and an increase in girls. With respect to the area of occurrence of the case, the behavior over time was preserved -no differences-. There were statistically significant differences in health status and ethnicity (p values <0.0001, for both). Patient hospitalization was similar in both years, close to 93%. The final condition of these minors was very close in both periods, since in absolute numbers by 2015 there were 57 deaths and in 2016 there were 54 (p values = 0.388). The type of cancer variable, obtained from its 13 categories, showed statistically significant differences (p value = 0.006). The municipality of residence in most cases was Cali with a percentage of 46.7% and 44.0% respectively in 2015 and 2016 (p value = 0.710) (Table 1).

The trend of cancer cases in minors reported during the two years was positive, given that a slope of 0.007 was obtained, indicating that the increase was 0.7% in total during the study period. In such a way that the cases were presented in a similar way in 2015 and 2016.

The behavior of notifications during 2015 was relatively stationary; however, there were two peaks, both with 12 reported cases of cancer in

Table 1. Description of the variables contained in the cancer notification form in children under 18 years of age. Comparative according to year. Cali, 2015 and 2016.

Variable		2015		2016		p-value
		n = 259		n = 284		
Age (Years)†		8.0	5.3	8.7	5.4	0.132
Opportunity for care†		57.0	81.1	49.3	72.8	0.248
Sex§	Male	155	59.8%	148	52.1%	0.070
	Female	104	40.2%	136	47.9%	
Area of case occurrence§	Municipal Cabecera	217	83.8%	239	84.2%	0.385
	Downtown	26	10.0%	34	12.0%	
	Rural Disperse	16	6.2%	11	3.9%	
Health Regime§	Contributing	106	40.9%	162	57.0%	<0,0001
	Subsidized	134	51.7%	118	41.5%	
	Special	9	3.5%	1	0.4%	
	Not Insured	6	2.3%	2	0.7%	
	Exception	4	1.5%	1	0.4%	
Ethnicity§	Other	227	87.6%	269	94.7%	<0,0001
	Afro-Colombian	19	7.3%	6	2.1%	
	Indigenous	12	4.6%	3	1.1%	
	ROM, Gypsy	1	0.4%	6	2.1%	
Inpatient§	Yes	240	92.7%	266	93.7%	0.645
	No	19	7.3%	18	6.3%	
Final condition§	live	202	78.0%	230	81.0%	0.388
	Dead	57	22.0%	54	19.0%	
Type of cancer	Non-hematologic	123	47,5%	148	52,1%	0.282
	Hematologic	136	52,5%	136	47,9%	
Municipality of residence§	Cali	121	46.7%	125	44.0%	0.710
	Other Department	72	27.8%	78	27.5%	
	Another municipality in the Valley	66	25.5%	81	28.5%	

§ Frequency (%). Chi-square.
† Average ± DE. T-Student.

minors, in weeks 18 and 36; while for 2016, the highest data was in the first epidemiological week with 10 reported cases, but the distribution was similar during the year (Figure 1).

Table 2 shows the comparison by social security health regime and type of cancer according to year of notification.

Figure 2 shows cumulative survival and the opportunity for care between the years 2015 and 2016.

According to the survival analysis, there were no statistically significant differences (p-value = 0.573) between hematologic and non-hematologic cancer, with respect to the timeliness of care for these minors residing in the city of Cali (Figure 3).

Information was collected on 259 and 284 patients for the years 2015 and 2016 respectively. The sex distribution was greater in men in the two years of the study. The most frequent pathology was Acute Lymphoid Leukemia, with 34.4% for 2015 and 31.3% for 2016 of the cases (Figure 4).

4. Discussion

This research opens a panorama in the framework of interventions for children with cancer, not only from the medical point of view but also from other disciplines that support public policies for the protection of children's rights in the context of oncological diagnosis. This implies the early detection of cancer, timely care, and reduction of cancer mortality rates in children and adolescents under 18 years of age through the creation and consolidation of databases that expedite detection, follow-up, comprehensive and immediate care and the consequent authorization of health care providers with respect to all care procedures.

Therefore, adequate treatment and medical and social support care depend on a multidisciplinary team and infrastructure enabled in the institutions to treat cancer patients, taking into account the minimum conditions for care and income of each country, which, as our data show, could improve the survival rate.

We believe that this can be achieved if the central axis is humanized and quality care with respect to the patient's right to be cared for in the framework of improving their quality of life and where research increases knowledge on the integral care of children with oncological diagnosis in order to consolidate sectorial and inter-sectorial care organizations with quality standards in the habilitation of Functional Units for the Care of Childhood Cancer.

One of the main richness of this research is the ethnic variability existing in Colombia, which allows us to make visible not only the white or Afro-American ethnic contrast, but also ROM, gypsy and indigenous groups, thus contributing to improve the representation of these population groups in the literature, as well as their specific report regarding their ethnicity [11]. In this sense, the differences obtained in health status and ethnicity showed statistically significant differences, as detailed in studies with diverse populations: adults with or without intellectual or developmental disabilities [12]; sexual minorities [13]; patients with different types of cancer [14, 15], where ethnicity was shown to be a common factor in health outcomes.

These ethnic disparities have been associated with the timeliness of health care and the incidence of some types of cancer. When comparing cancer mortality in children, no statistically significant differences were observed according to the type of health system affiliation. In countries where the health service is equal for all, the European Union shows an
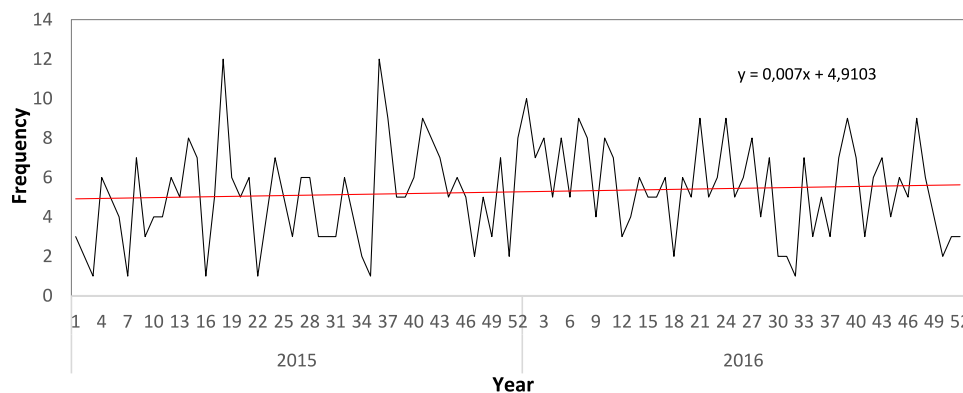

Figure 1. Trend in the number of reported cases of cancer in children under 18 years of age according to the year and epidemiological week of the report. Cali, 2015 and 2016.

Table 2. Average and medium of survival times by social security health regime and type of cancer in children under 18 years of age according to year of notification. Cali-Colombia, 2015 and 2016.

Variable	Category	Average[a]				Medium				p-value*
		Estimate	Standard error	95% confidence interval		Estimate	Standard error	95% confidence interval		
				Lower limit	Upper limit			Lower limit	Upper limit	
SGSSS Affiliation	Contributing	224,743	16,891	191,637	257,849	271,0	45,231	182,347	359,653	0,509
	Subsidized	217,883	15,597	187,313	248,454	231,0	22,885	186,146	275,854	
	Global	222,278	11,275	200,179	244,378	231,0	25,984	180,072	281,928	
Type of cancer	Non-hematologic	231,366	15,578	200,833	261,900	341,0	95,959	152,920	529,080	0,573
	Hematologic	213,531	16,194	181,791	245,270	224,0	9,898	204,601	243,399	
	Global	222,278	11,275	200,179	244,378	231,0	25,984	180,072	281,928	

[a] The estimate is limited to the longest survival time, if censored.
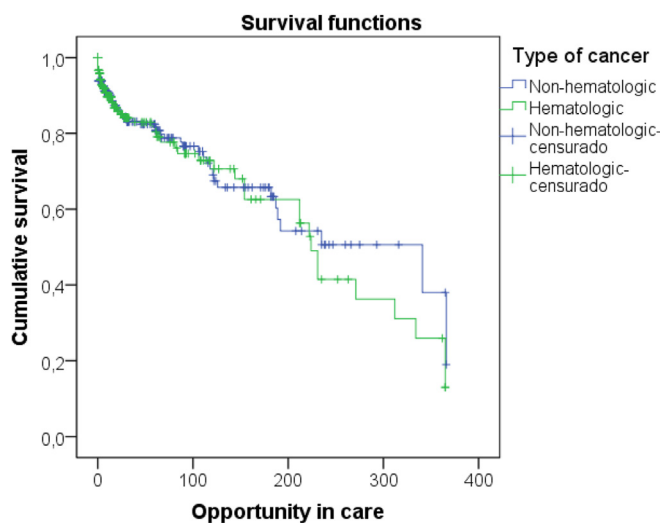* Log Rank (Mantel-Cox).
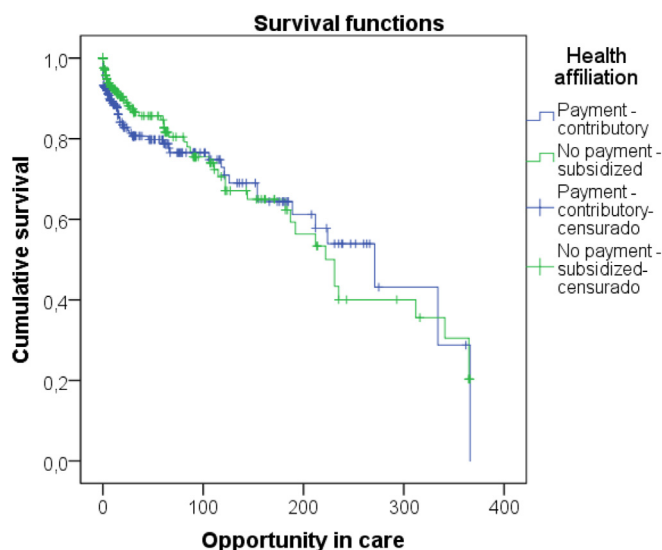
Log Rank (Mantel-Cox) P-value = 0.509

Figure 2. Cancer survival curve in children under 18 years of age according to the year of notification, comparative according to health system affiliation. Cali-Colombia, 2015 and 2016.

Log Rank (Mantel-Cox) P-value = 0.573

Figure 3. Cancer survival curve in children under 18 years of age according to the year of notification, comparative according to type of cancer. Cali-Colombia, 2015 and 2016.

improvement in its indicators of the health status of its population [16], the same happens in the United States where, in spite of the economic disparity of its population, it shows improvement in its health indicators. In Colombia, the perception of the health system in which the public system improves the health outcomes of the population, at least between 2015 and 2016, equality was found in mortality from pediatric cancer, related to inclusion in the health system [17].

Colombia's Law 1388 of 2010 seeks to reduce the mortality rate due to cancer in children and people under 18 years of age, and in Resolution 2590 of 2012 to improve the Integrated Network System and the National Information System for Monitoring, Follow-up and Control of Cancer Care in children under 18 years of age [7, 8, 9]. Under both regulations, the pediatric oncological population is considered a special population that requires follow-up and immediate notification. For this reason, the report of cancer cases in the pediatric population has shown a slight increase in the number of cases notified by the treating entities in the city of Santiago de Cali between the years 2015 and 2016, in which they were notified according to the files notified to the SIVIGILA of the municipal health secretariat of the city of Cali with behaviors similar to the world report of cancer incidence [18].

According to the National Cancer Control Plan 2012–2020, it directs the financial and health regime to maximize the impact on cancer control. But this progress has difficulties in practice due to two reasons: the first is that the institutions that offer services are private institutions that do not have the conditions to provide comprehensive care to children with cancer, which we believe is related to the second reason, which is that in Colombia the provision of outpatient, chemotherapy or hospitalization services for children with cancer is allowed without the condition of being integrated into the same institution, which consequently hinders comprehensive and continuous care.

Likewise, it is identified that most of the notifications are offered by oncology centers (of the 25.45% of the notifications of childhood cancer, 95.6% are notified in specialized centers), which shows that the primary levels of health care do not establish diagnostic probability, and if they do, it is not notified. In addition to this, there are weaknesses in the confirmation of diagnosis in non-oncology centers, which slows down referral to specialized centers, all to the detriment of current regulations regarding the care of children under 18 years of age with suspected cancer (Res. 2590 of 2012).

Between 2015 and 2016, 259 and 289 new cases of childhood cancer were reported respectively in the city of Santiago de Cali, capital of the
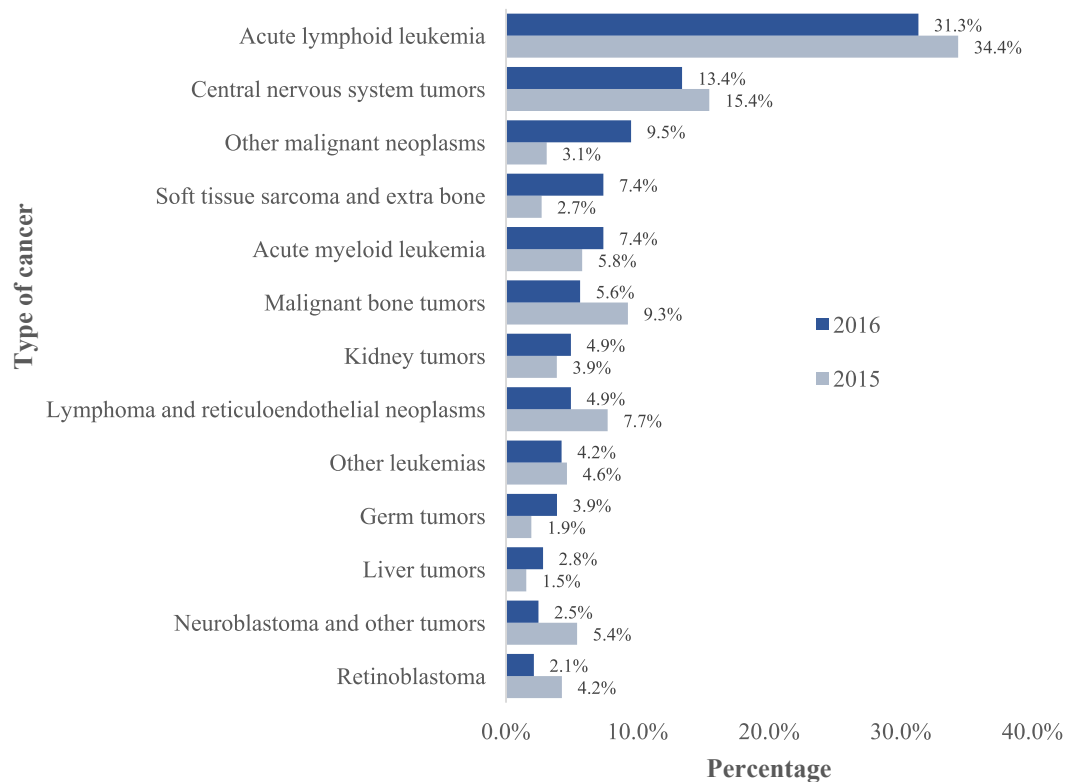
Figure 4. Distribution by type of cancer. Children under 18 years of age according to year of notification. Cali-Colombia, 2015 and 2016.

department of Valle del Cauca, in ages between 0 and 15 years. During the study period it was observed that in the last two years the increase per epidemiological week is of 0.7% of the cases of infantile cancer in the city, being the group of Leukemias those of greater notification in a 34.4% and 31.3% in the years of study. Although the slope is positive, the value is not significant, which indicates that the behavior of infantile cancer is irregular and is not related to time.

However, the global picture is different, in terms of epidemiological surveillance, there is a shift towards non-communicable diseases, where cancer is the leading cause of death with an incidence of 18.1 million new cases of cancer in 2018 to 29.5 million new cases in 2040, adjusted to population growth [19].

The implications of comparing two years, on the timeliness of care for these children with cancer, lie mainly in the administrative response capacity of the health care institutions, which are reflected in the data recorded in the territorial entity, which is the regulating entity for the provision of timely and quality services for these children. In addition, it is known that when a child with cancer is attended in a timely manner, the consequences of the cancer are lessened and this has a positive impact on the child's health.

According to the results of this study, both years presented a similar behavior in the timeliness of care for children with cancer, therefore, new developments are suggested to continue monitoring this.

Leukemia in children continues to be a common cancer in the population of the Cauca Valley and the world [20, 21]. In comparison with previous analyses of sociodemographic results of the situation observed in Latin America and in Colombia, mainly in the city of Santiago de Cali, it is observed that Leukemia in the Lymphoid variant is the first cause of death in children under 15 years of age and of predominance in the male population [18], due to conditions of social inequality, in which inter-institutional collaboration and specialized personnel are deficient [19].

The decrease observed in cancer mortality in children under 15 years of age during the study period remains slight when compared to the reductions that have been registered in previous years [3, 5]. Such

reduction reflects, the behavior of the tendencies in the mortality of the most important types of cancer in which the tendency to the rise of the Acute Lymphoid Leukemia and the Tumors of the central nervous system persists, whereas the Acute Myeloid Leukemia showed a tendency to the fall in the present as opposed to the world-wide behavior [21, 22, 23].

With respect to ethnicity, it was identified that there is a great problem in the typing and identification of ethnicities by health professionals or persons in charge of filling out the SIVIGILA notification forms. This is serious, given the current developments in population genetics, in which genetic ancestry is related to diverse pathologies characteristic of the ethnic group. As well as the efficient pharmacological interaction for future intervention [22].

Finally, according to the result of the Log Rank test, it is established that there are no statistically significant differences in cancer mortality in minors according to the health affiliation regime (contributory vs. subsidized), which is related to the recommendations for cancer care from a new health system for the next century [5], the reduction of social inequities [24], primary interventions [25] and early diagnosis [26].

Although having primary data on the state of cancer in Colombia is a starting point demanded by cancer observatories around the world, as a research team we recognize that evidence-based prevention [27] and monitoring of the state of cancer in Cali is part of the challenge for public health policies that cancer offers for collective health and those involved in it in Latin America [28].

Declarations

Author contribution statement

Ángela María Jiménez Urrego, Mauricio Hernandez-Carrillo, Ana Gisset Gutierrez-Posso, Jorge Alirio Holguín Ruiz, Guillermo Perlaza-Peláez, Alejandro Botero Carvajal: Analyzed and interpreted the data; Wrote the paper.

Mario Calero-Flórez: Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

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